

Using Built In Test Signals on ORDA

ORDA Systems Engineering

There are 4 Built In Test Equipment (BITE) signals available for use the WSR-88D. These signals can be injected into 2 different places in the receiver, and can be attenuated from 0 to 103dB. The values for these signals must be matched to the levels the receiver can handle, and must overlap the dynamic range of all the receiver components to be able to thoroughly test them. This paper will explore the levels of the BITE signals and their usable ranges with ORDA installed into the WSR-88D.

The paths the signals must travel differ between legacy and ORDA due to the removal of legacy IF and analog components in ORDA. This changes the receiver gain, and thus the ranges of the BITE signals. The paths typically known as the “critical” paths for the test signals do not change, but the shared path does. Figure 1 shows the “critical” paths for the 4 test signals, and Figure 2 shows the difference in shared path (note that R41 is not the path loss, but the matched filter loss on the return signal). The “R” and “TR” values represent the Loss or Gain for each particular path (adaptation data). In the following analysis, the mean values from Attachment 1 of EHB-6, Maintenance Note 30ⁱ were used (also listed in Appendix 1 here).

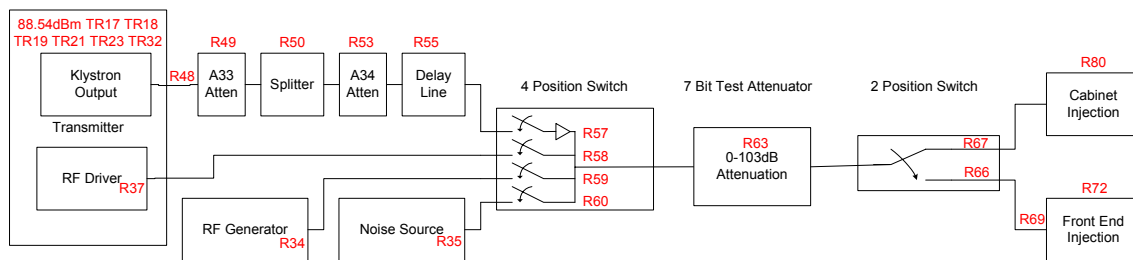


Figure 1, Critical Paths

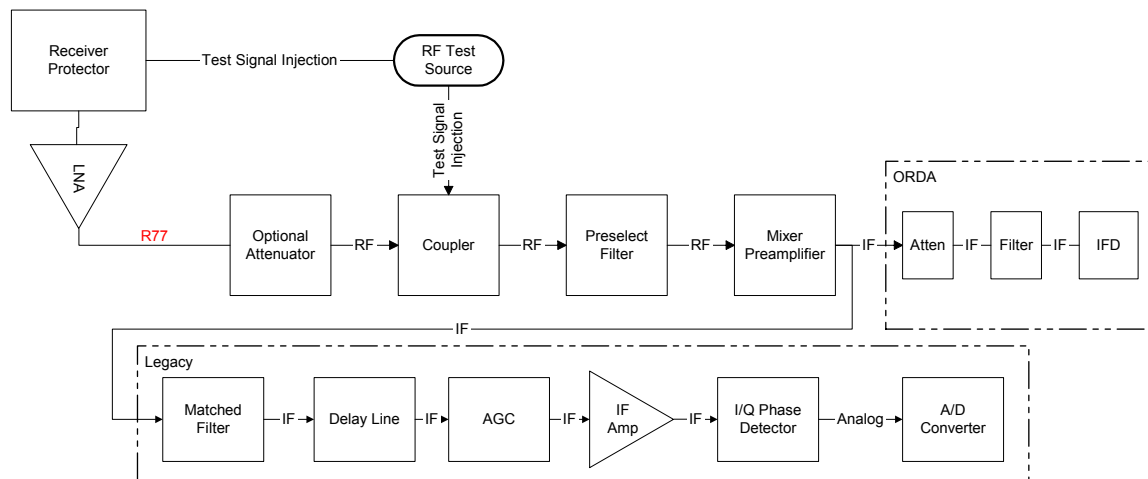


Figure 2, Shared Paths

Table 1 shows the maximum signal (0dB attenuation selected on the 7-Bit Test Attenuator) injected into the A/D Converter for both ORDA and legacy:

	Front End Injection		Cabinet Injection	
	Legacy	ORDA	Legacy	ORDA
CW	43.536496	24.5578	24.3257	5.347
RFD	43.828496	24.8498	24.6177	5.639
KD	18.574896	-0.4038	-0.6359	-19.6146
Noise	20.918496	1.939796	1.7077	-17.271

Table 1, Test Signal Power

For Table 1, noise is the gain through the receiver channel, critical and shared path. All values are dBm, and represent peak power. The KD value is based on a 700kW (88.54dBm) peak transmit burst.

We will concentrate on the ORDA portion of the table. SIGMET specifies that the input to the IFD saturates at +6dBm. However, with their statistical linearization, they can recover another 4-6dB. We'll assume 4dB here, making the IFD saturation point +10dBm.

We can see from Table 1 that there is a 19dB signal strength difference between injecting in the Cabinet vs the Front End, primarily due to the LNA. The main signal ORDA will be using for calibration routines will be CW, so we'll concentrate on that, and briefly look at the other signals.

First, all ORDA signals are approximately 19dB lower in power because of IF component removal. This brings the test signal power down, and actually makes them match the system closer.

For CW, Cabinet Injection will bring a maximum signal into the IFD of 5.3dBm, matching well the saturation limit of the IFD (before linearization). Because the 7 bit test attenuator spans a range of 103dB, we can also use the Front End Injection point over the entire dynamic range also. The different power points of the Injection points allows us to test over the entire range of the receiver. Most calibration tests will be injected at the Front End to best simulate the entire receiver chain's affect on received signals.

Figures 3 and 4 show idealized curves for the range of the 7 bit test attenuator with CW injected into the Cabinet and Front End, respectively. In the ROC test reportⁱⁱ, it states that attenuations below 14dB injected into the Front End cause the LNA to compress, and the Front End Injection shows this range of attenuation is also above the linear range of the SIGMET IFD. Therefore, for ORDA, we can ignore LNA compression since a signal the LNA compresses will be above the compression limit of the SIGMET IFD.

Testing with SIGMET's utility ascope at KJIM shows good agreement with the curves shown.

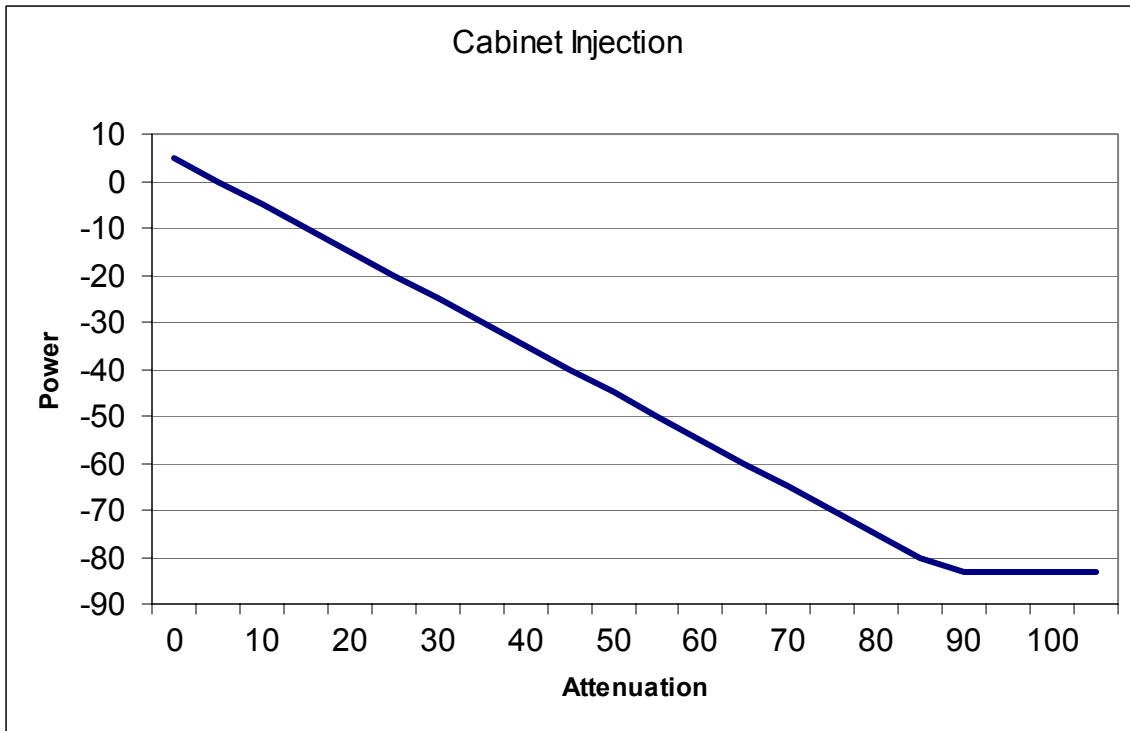


Figure 3, Cabinet Injection

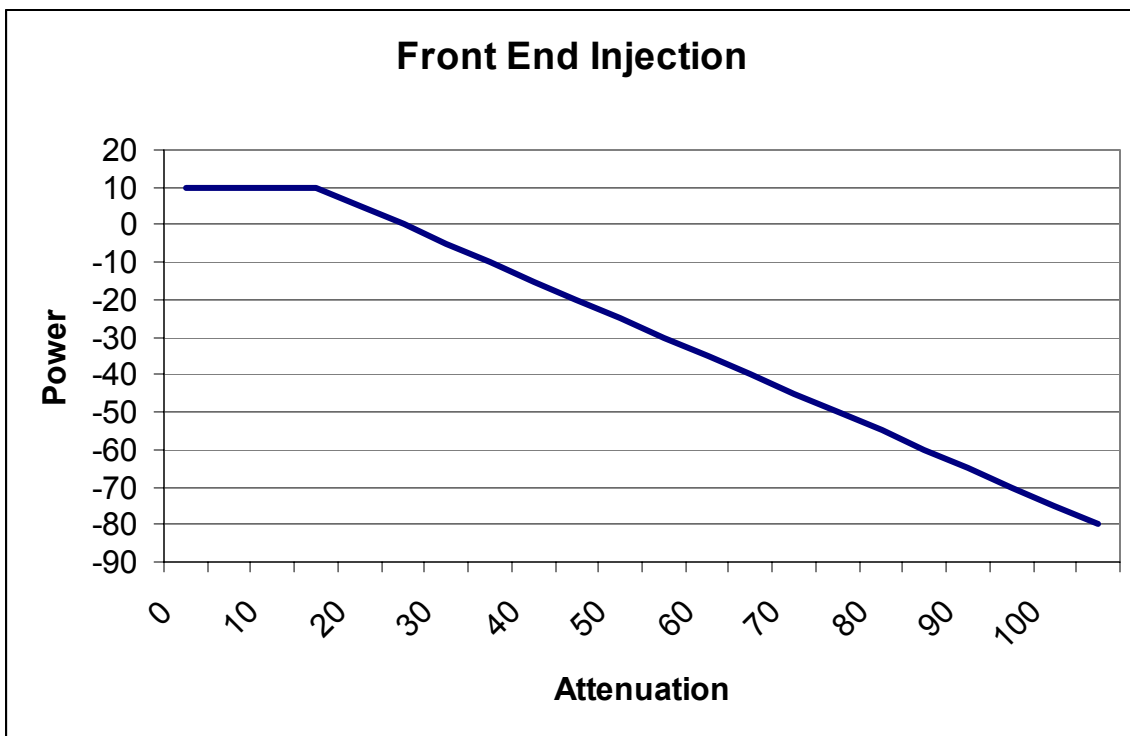


Figure 4, Front End Injection

Appendix 1

Following are adaptation values from Attachment 1 of EHB-6, Maintenance Note 30. A 30M tower is assumed.

Adaptation Data	Value
A1	45.8
R34	22.54
R35	62.68
R37	25.1
R48	-0.6659
R49	-5.85
R50	-6.33
R53	-10.229
R55	-44.84
R56	-2.378
R57	13.51
R58	-1.862
R59	-1.972
R60	-2.05
R63	-6.007
R66	-1.95
R67	-1.56
R69	-3.6
R72	-20.2
R73	-0.6513
R74	27.88
R77	-3.46
R78	-0.5872
R79	-0.0007
R80	-20.22
R81	-2.224
R83	19.79
R84	3.97
R88	-8.992
R91	-6.854
R92	0.3847
R94	39.64
R98	-10.2
TR7	1.44
TR17	-0.0527
TR18	-0.159
TR19	-0.162
TR20	-0.042
TR21	-0.135
TR22	-0.05
TR23	-34.91

TR24	-0.059
TR25	-1.2
TR26	-0.06
TR27	-0.11
TR28	-0.057
TR29	-0.0939
TR31	-0.106
TR32	-3.02
TR34	-0.205

ⁱ NWS: EHB-6, Maintenance Note 30, Appendix 1

ⁱⁱ Correcting the Mis-calibration of the Radio Frequency (RF) Test Attenuator under the Radar Data Acquisition System Operability Test (RDASOT) DYNRANGE Routine, William Urell and Ron Fehlen, ROC Report, March 2002